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(54) Cheque Writing Apparatus

(57) Apparatus for writing cheques to be drawn on different accounts has a keyboard for entering the sum to be paid and data to identify cheque type, which data is stored in a memory in the form of X and Y coordinate position data defining the print start locations on each of the date line, payee identification line and cash amount line for the particular cheque type concerned. A micro-processor utilises this data to control a multiple head printer, which writes the cheque in accordance with the keyboard entered information and memory-stored information, e.g. payee identification and date. An embossing station may be provided at which the raised information on a cheque guarantee card is marked on to the back of the cheque.

No means for entering trans information

No secure unit

No means for communicating

GB 2 081 185 A

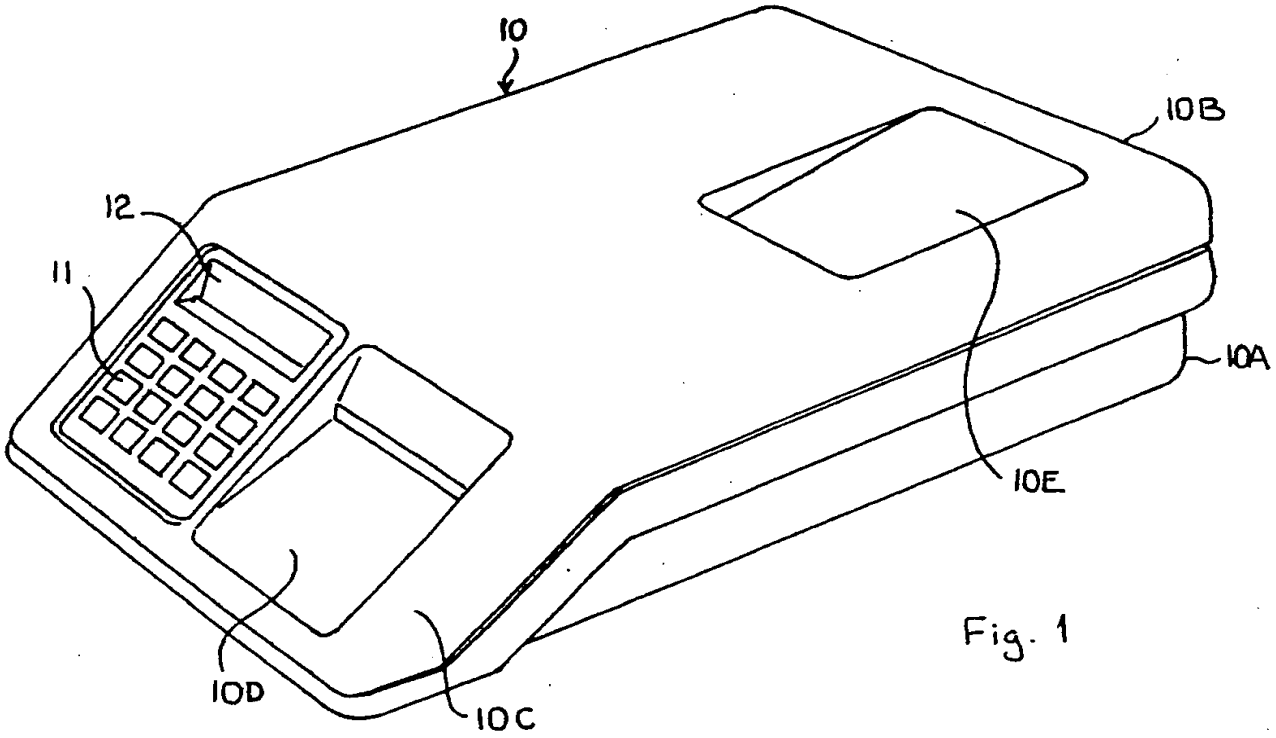


Fig. 1

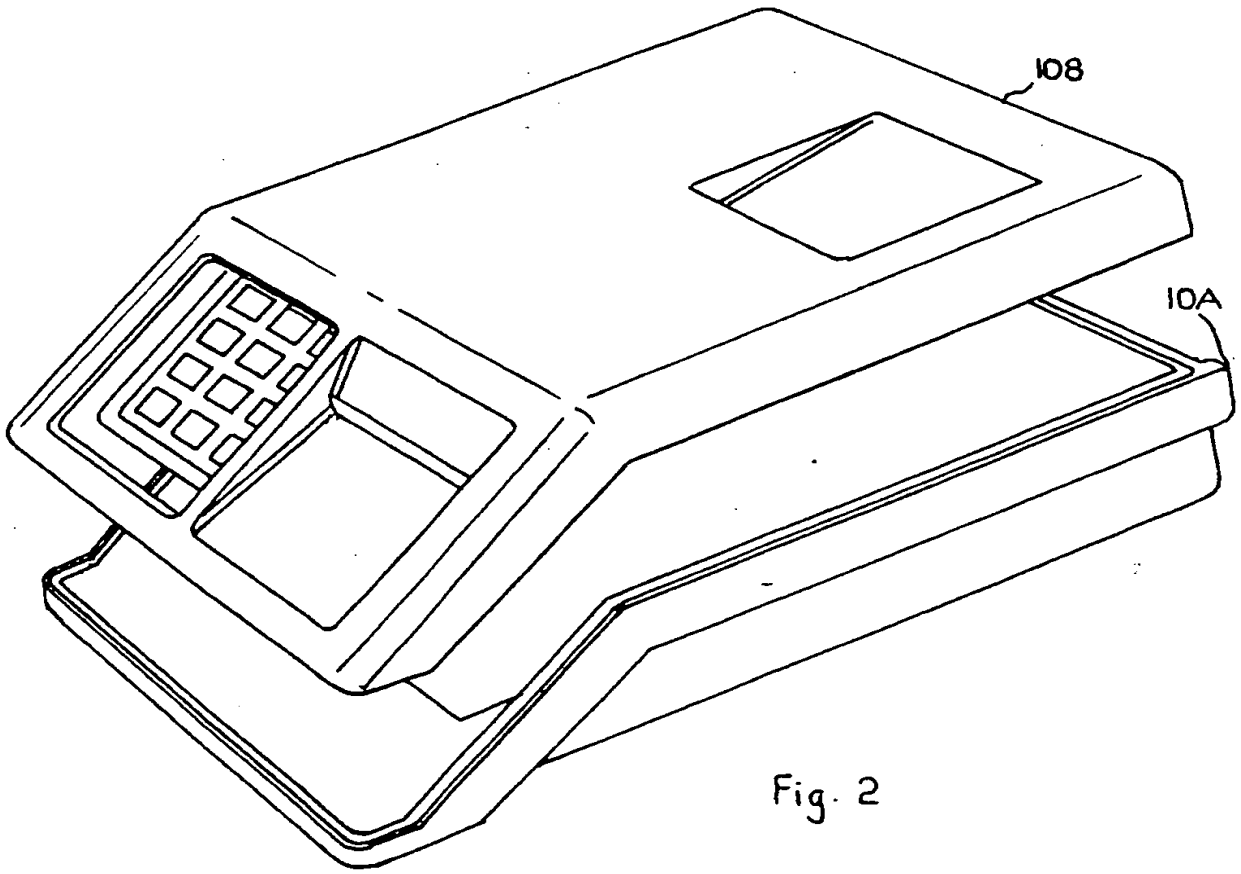


Fig. 2

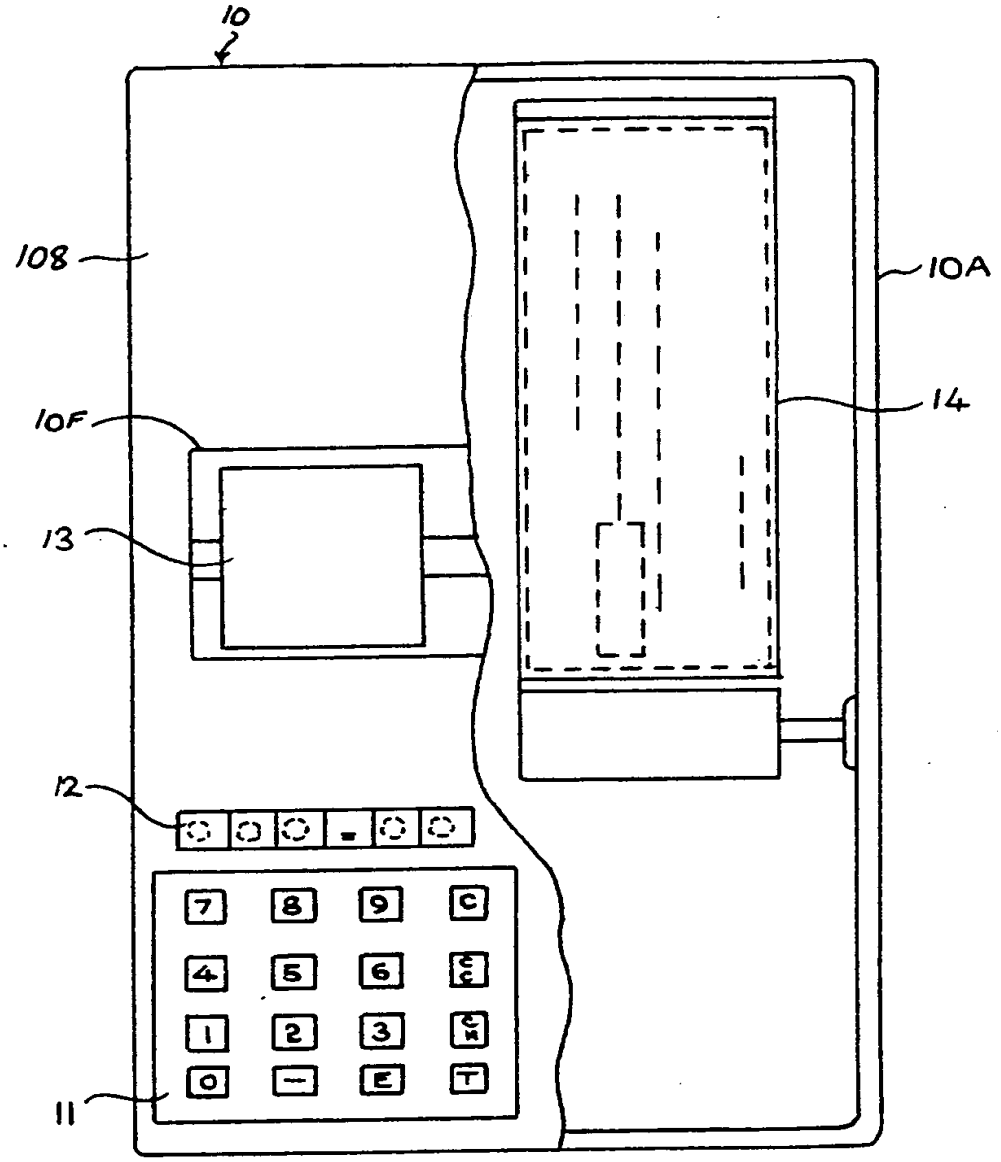


Fig. 3

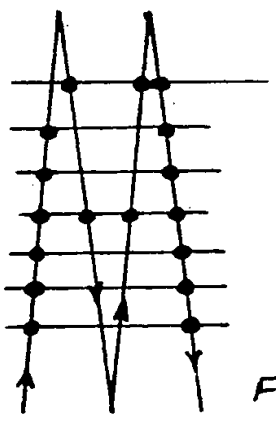


Fig. 7A

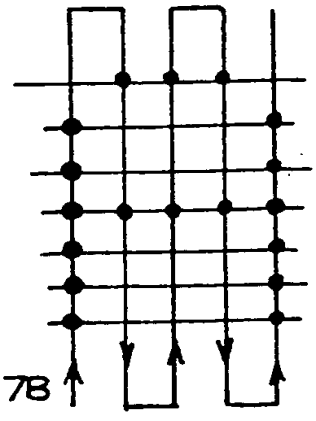


Fig. 7B

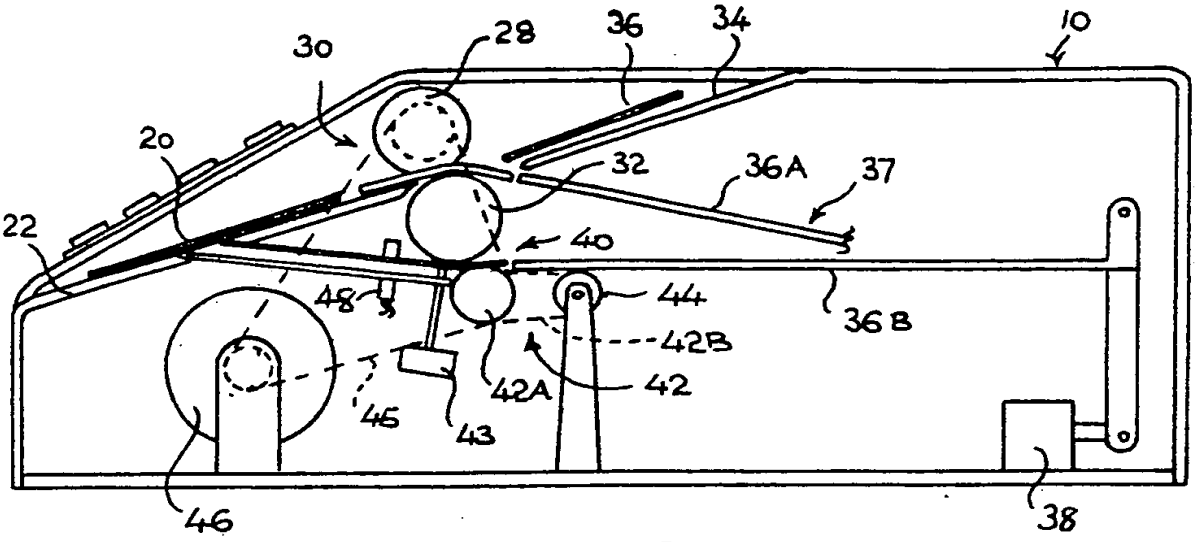


Fig. 4

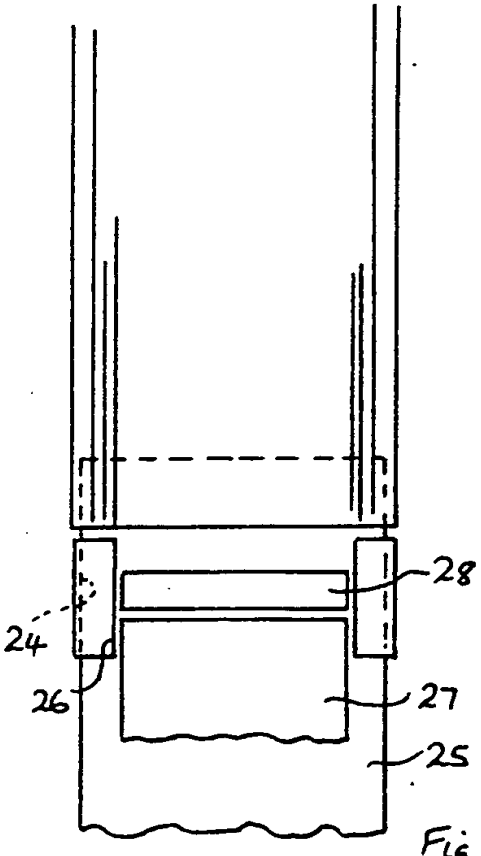


Fig. 6

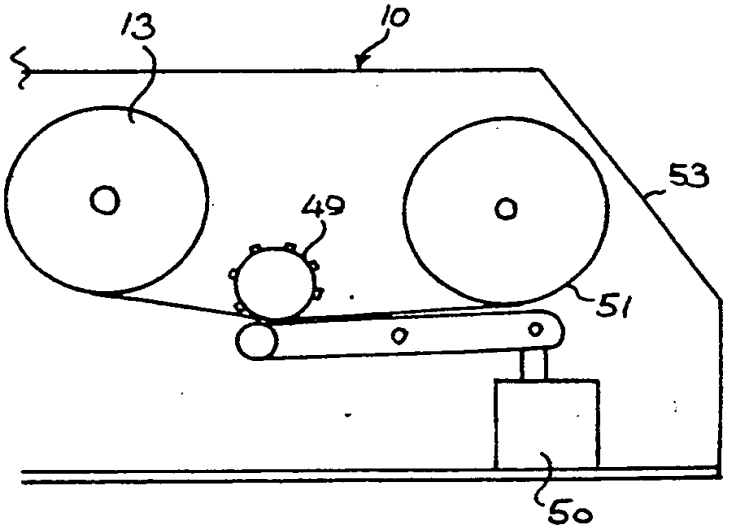


Fig 5

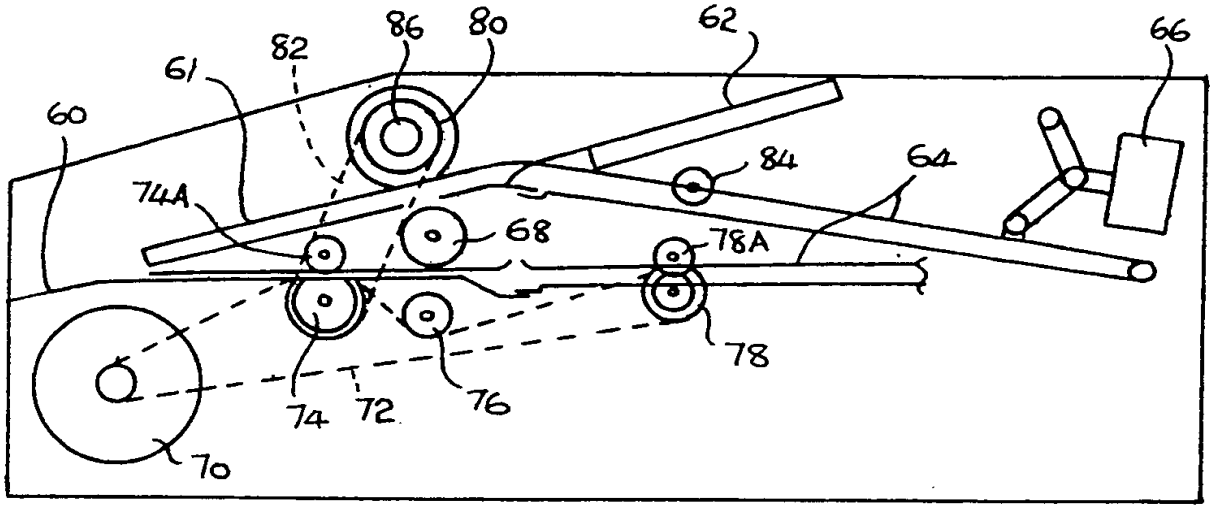


Fig. 8

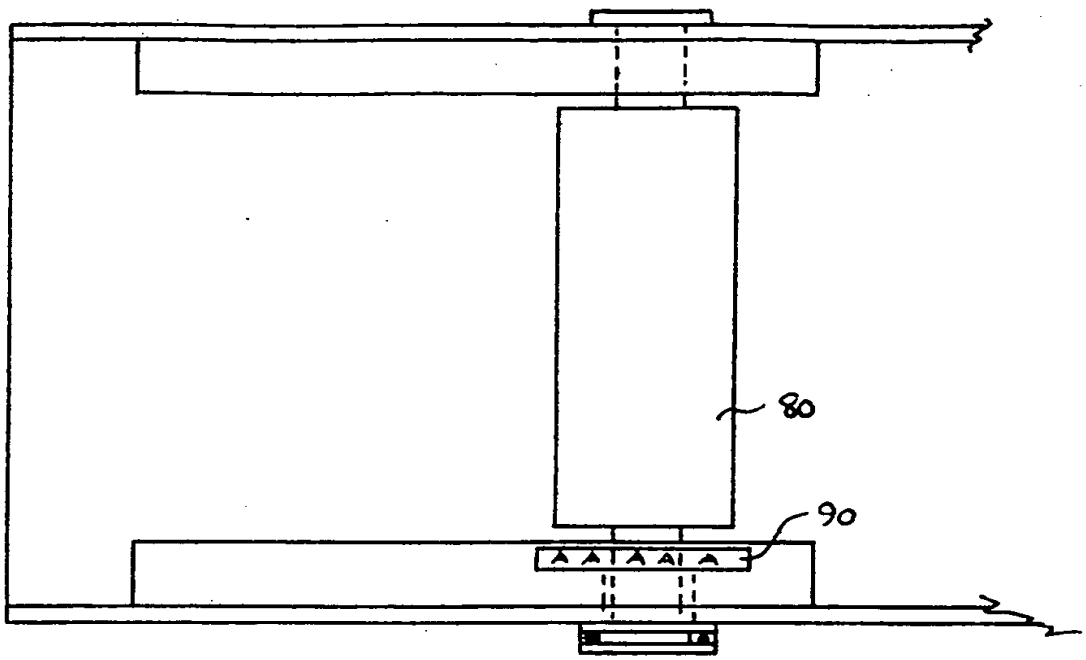


Fig. 9

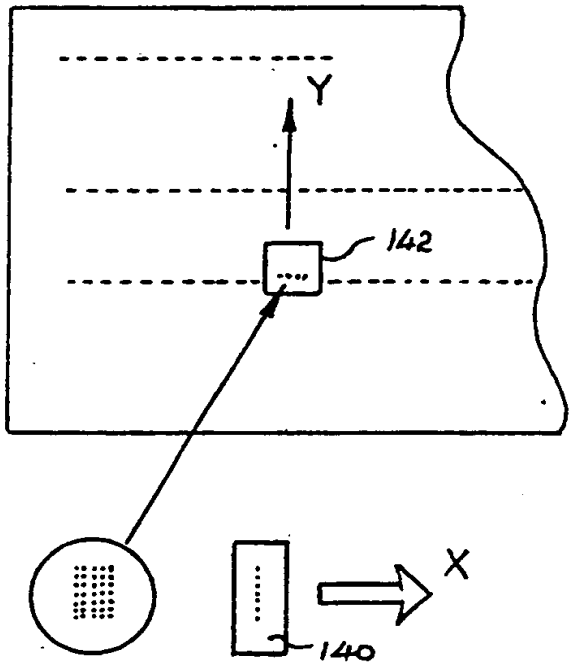


Fig. 12

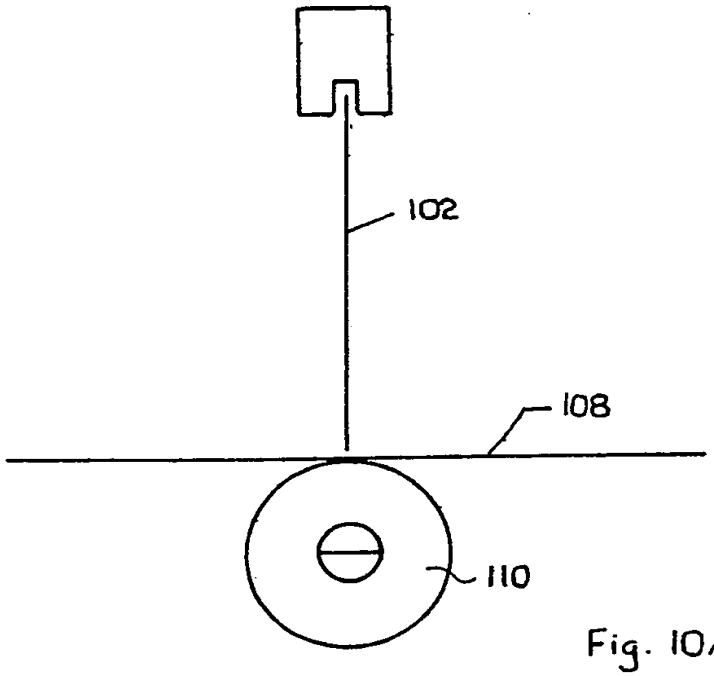


Fig. 10A

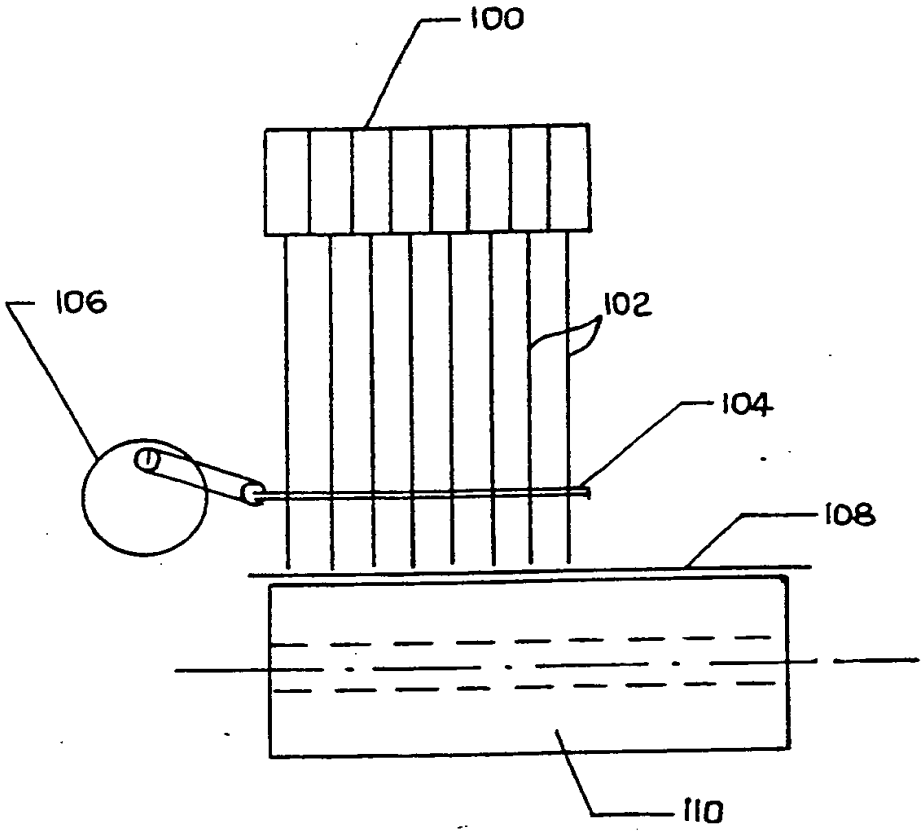


Fig. 10B

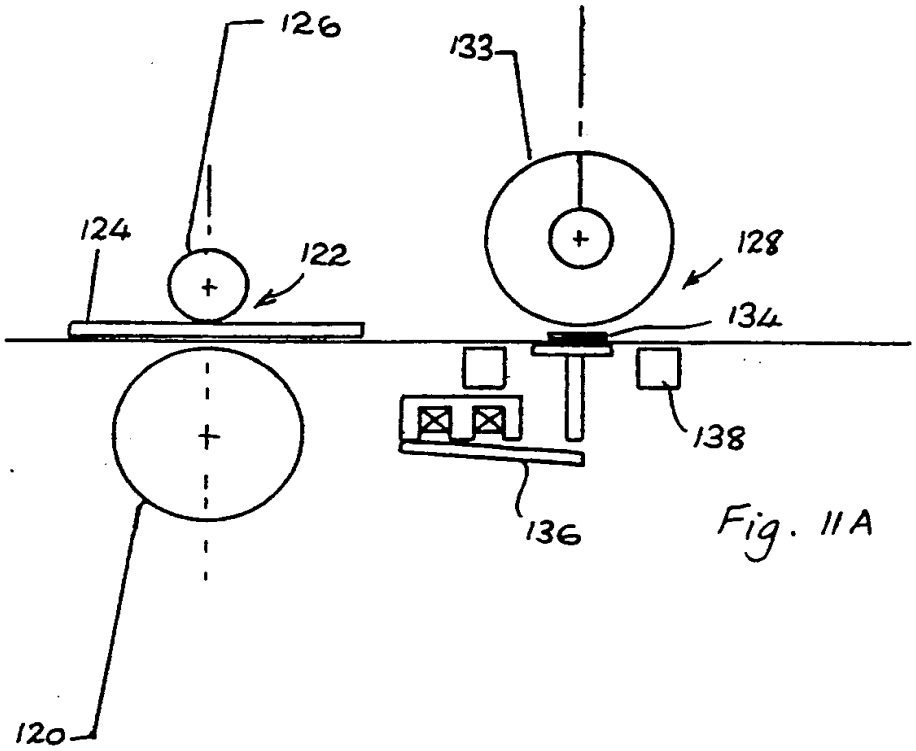


Fig. 11A

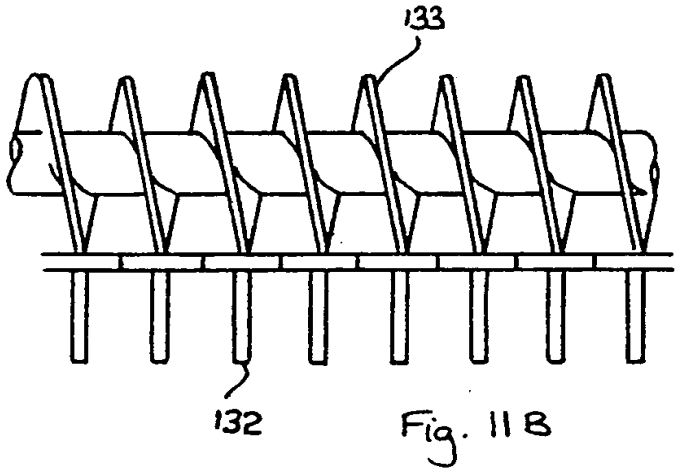
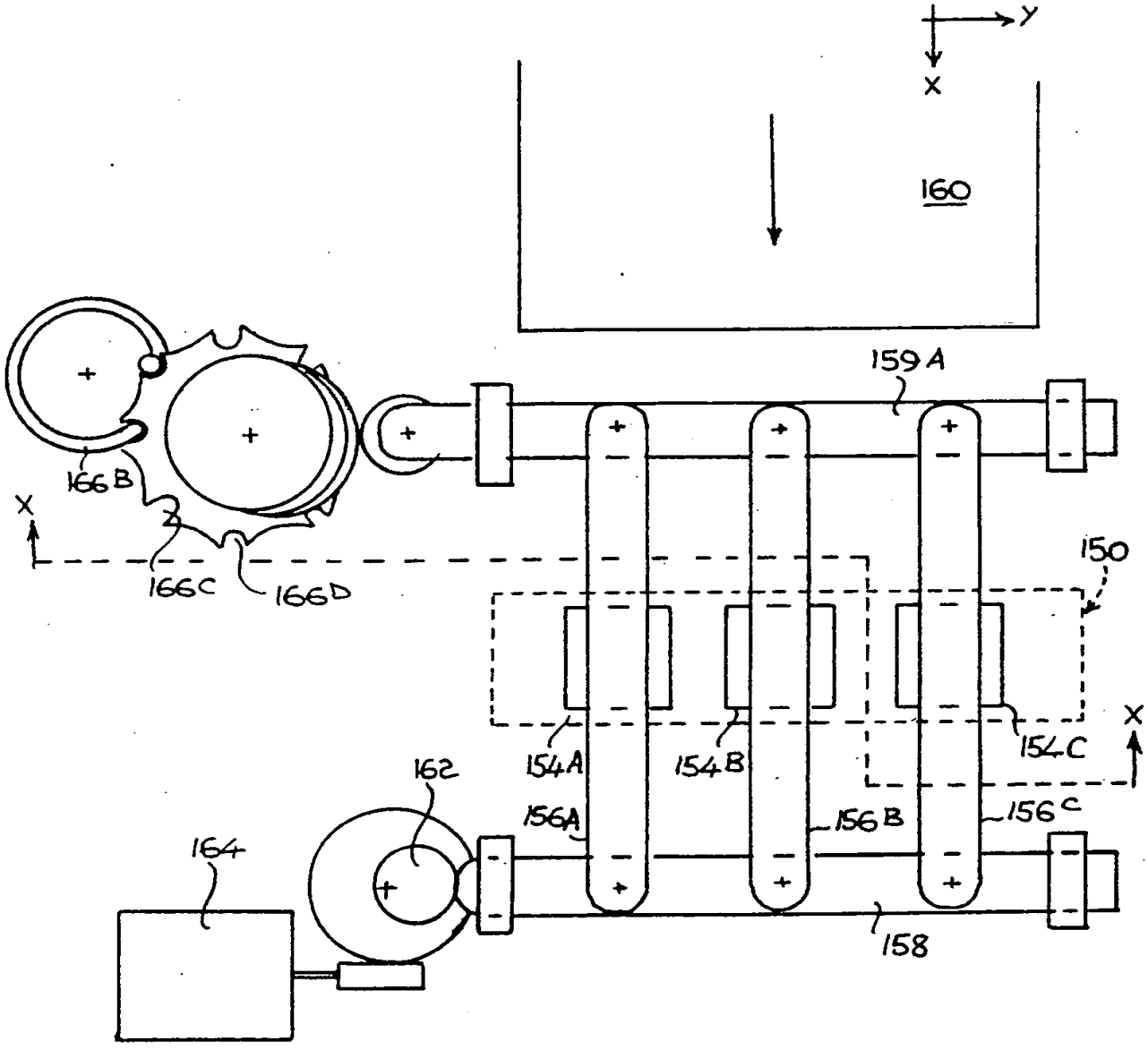


Fig. 11B


Y
X
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166B
166C
166D
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154B
154C
X
162
156A
156B
156C
164
158

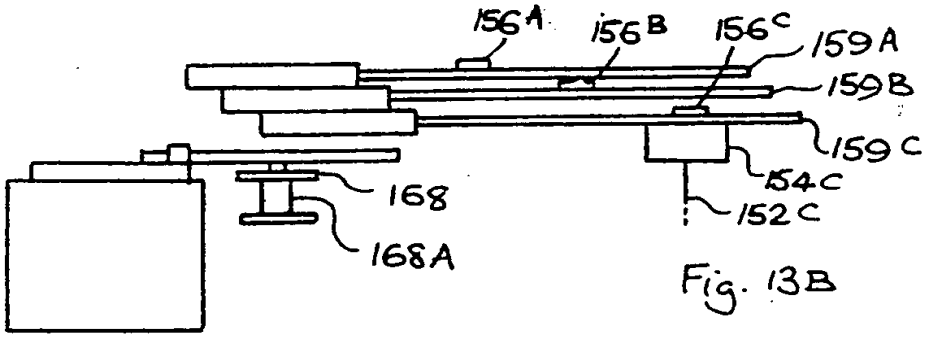
156A
156B
156C
159A
159B
159C
154C
152C
168
168A

Fig. 13B

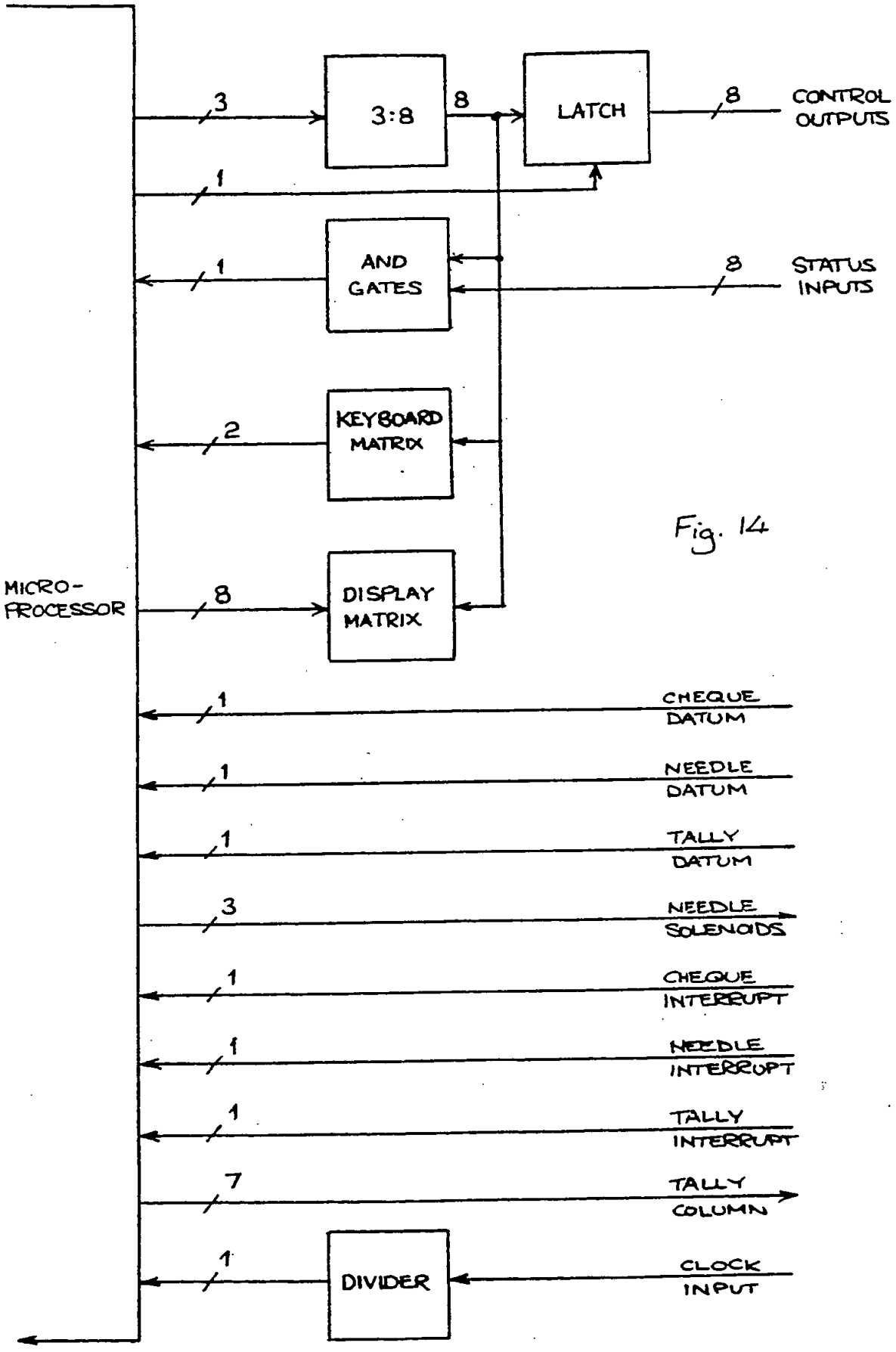
3
3:8
8
LATCH
8
CONTROL OUTPUTS
1
1
AND GATES
8
STATUS INPUTS
2
KEYBOARD MATRIX
MICRO-PROCESSOR
8
DISPLAY MATRIX
1
CHEQUE DATUM
1
NEEDLE DATUM
1
TALLY DATUM
3
NEEDLE SOLENOIDS
1
CHEQUE INTERRUPT
1
NEEDLE INTERRUPT
1
TALLY INTERRUPT
7
TALLY COLUMN
1
DIVIDER
CLOCK INPUT

Fig. 14

SPECIFICATION

Cheque Writing Apparatus

Field of the Invention

This invention relates to cheque writing apparatus, and more especially to apparatus for writing customers' cheques in payment for goods purchased in shops and stores.

Background to the Invention

Payment by cheque is a common method of payment in shops, since the customer is not required to carry large sums of money or to incur debts on a credit card. However, writing a cheque can be a slow procedure which delays other customers and reduces cashier productivity. For example, cheque writing can often involve various incidental actions, additional to the basic actions necessary, such as borrowing a pen, checking the date with the cashier, checking the name of the payee with the cashier, checking the amount with the cashier, and the cashier copying the cheque card number on to the back of the cheque.

A rapid cheque acceptance system to reduce the number of actions involved in cheque writing, especially incidental actions, and which would maintain or improve the quality of cheque verification, would therefore be highly desirable. It is an object of this invention to provide a cheque writing machine which materially contributes to rapid cheque acceptance.

The Invention

According to the invention, there is provided cheque writing apparatus comprising means for transporting a blank cheque to a printing station and for transporting a written cheque from said station, a multiple head printer at the printing station, a keyboard for entry of the cheque type and the cash amount to be printed, a memory for storage of date, payee identification and positional data for printing in relation to the cheque type, a drive mechanism for the multiple head printer, and a microprocessor for controlling the drive mechanism for the printer in relation to the cheque transport means to cause the printer to complete the writing of the cheque responsive to the entered keyboard information and the information in the memory.

Cheque writing apparatus *per se* is, of course, well known. However, such known apparatus is directed to the writing of cheques for and on behalf of individual companies or organisations, so that all the cheques will have the same format and layout, possibly specifically designed to suit the machine in which they are to be written. In contrast, customers paying by cheque in shops will present a range of cheques of differing formats and layouts, and the apparatus in accordance with the invention is intended to meet this situation, at least to the extent of being able to handle the normal cheque issues of the major banks.

In a preferred machine in accordance with the invention, a blank cheque, together with the customer's cheque card, are located in the machine input. The cashier uses a numerical keyboard to enter information derived from the face of the cheque such as the first two digits of the bank code, thereby identifying the cheque type, together with the cash amount to be written. Cheque writing is then initiated by pressing a start button.

First, the cheque and cheque card are transported end-on to an embossing station, where the back of the cheque is marked with embossed information on the cheque card. This marking is preferably effected by a cheque card drive roller which is spring loaded towards an ink roller, but not allowed to make contact therewith to prevent smudging of cheques due to any ink deposits on the drive roller. The position drive then takes place between the card drive roller and two auxiliary rollers, on the same shaft as the ink roller but of slightly greater diameter. In addition to marking the back of the cheque with the information embossed on the cheque card, the embossing mechanism can include a special print wheel which serves to provide an embossed image on the back of the cheque relating to payee identification, e.g. the branch location of a multiple store, or a store department identification.

The cheque card and cheque are then separately routed, the card passing to a machine output and the cheque being transported to a printing station. Conveniently, the cheque may be transported forward past the ink roller, displaced laterally and then brought back to the other side of said ink roller, so that a common ink roller can serve for both embossing and printing, the respective stations being located on opposite sides of said ink roller. A solenoid may be used for laterally moving a supporting tray for the cheque from the embossing station output path into the input path to the printing station, the tray being spring loaded towards the embossing station in order to minimise the time for which the solenoid is activated. The drive rollers and reaction rollers employed for cheque transport are preferably spring loaded into contact to ensure a positive drive for the cheque without overloading. It is also preferred to use a single motor both for driving the cheque and cheque card through the embossing station and the cheque past the printing head. Toothed belts may be employed in transmission, whereby the motor drive can be unidirectional. The driving arrangement may incorporate an intermittent drive such as a discontinuous worm or geneva wheel mechanism or the like, so that cheque transport is intermittent past the printing heads, thereby to ensure acceptable print quality.

For printing, it is preferred to employ an elemental printing method such as dot matrix printing. Upper case, i.e. capital, letters are acceptable, so that a 7×5 dot matrix format can be used. As the cheque is again presented end-on, the date line, payee identification line and cash amount line can be printed simultaneously in

parallel. In order to achieve a sufficiently fast total print time, multiple print heads must be employed. However, within this constraint, various options are available to carry out the dot matrix printing, in all cases moving the cheque in the X-direction (longitudinally of the cheque) and scanning the print heads in the Y-direction at right angles to the length of the cheque. For example, if fast accelerational forces can be achieved and accepted, a multiple head comprising an array of five print needles extending in the X-direction can be scanned in the Y-direction to cover the complete band of the cheque (about 40 mm deep) incorporating the three print lines. Alternatively, an eight needle printer can be used, with needles spaced in the Y-direction each covering 5 mm of the cheque height during scanning.

However, the preferred machine employs three print heads, preferably single wire needles, one for each print line, which prior to scanning are selectively adjusted to appropriate base levels corresponding to the respective print lines. This steering adjustment may involve a movement in the Y-direction up to 10 mm. Subsequently, the three print heads are simultaneously and equally scanned in the Y-direction to cover the 7 dot high dot matrix format, i.e. 7 dots spaced about 0.5 mm apart for acceptable font dimensions of 3×2 mm. Thus, the advantage of this preferred scanning system is that redundant scanning between the print lines on the cheque is avoided. However, the machine has to be capable of the initial selective steering adjustment for the print heads. This is made possible by the memory and microprocessor, which also control actuation of the print needles in accordance with the printing to be effected on the cheque, as will be explained hereinafter.

Thus, a non-volatile read-only memory is provided to provide all the necessary information for operation of the dot matrix print heads. This memory includes an ASCII to dot matrix table, covering the full range of characters to be printed; a cheque datum table giving the X and Y coordinates of the datum positions (commencement of printing at the levels corresponding to the print lines) for all the differing types of cheque which can be handled; a number table, giving the alphabetic forms of the nine numerals, together with special forms for multiples of 10 and 10 to 19, as necessary for writing of the cash amount in semi-alphabetical form in front of the numerical cash box on the cheque; a name of store table for payee identification. In addition, the microprocessor has a clock input which, amongst other functions, enables maintenance and updating of a perpetual calendar, which stores the date in numerical form. Accordingly, the ROM may also include a month table giving the month in words as a function of the month in numerals, thereby to enable the date to be written on the cheque in the preferred manner. Again, the microprocessor controls a display, in particular enabling the operator to check entries made on the keyboard, so that the ROM additionally includes a binary coded decimal to seven segment table, giving the seven segment form of each of the numerals capable of being displayed. The memory facility in the machine is completed by a volatile random access memory in which data arrays are generated.

In use, a printing needle oscillator interrupt handler controls needle activation (say at 350 Hz), taking the decision on each interrupt whether or not to operate a needle solenoid (on any one of the three print lines) dependent on the needle position during scanning in the seven dot high column of the dot matrix format, the position of the column within the character being formed, and the position of the character within the text being printed. At the same time, the microprocessor controls the intermittent advance of the cheque past the print heads in relation to scanning, the scanning movement preferably being effected by use of the same drive motor used for cheque and cheque card transport. As previously mentioned, a discontinuous worm may be included in the transmission from the motor to the cheque, so that transport of the cheque at the printing station is intermittent. No synchronisation signals are then necessary. Initially, the base levels of the three print needles can be brought into correspondence with the levels of the print lines on the cheque by use of a second motor and a Geneva mechanism, utilising the Y-coordinate positional data in the ROM addressed following the entry at the keyboard of the first two digits of the bank code. The entries at the keyboard are sensed in a conventional manner, with debouncing.

The printed cheque may exit from the machine at the input point initially mentioned.

The preferred machine also incorporates a tally roll printer, which may be a conventional ink-roller print mechanism, or a conventional thermal or electro-sensitive dot matrix printer, or a printer which utilises the print heads already provided in the machine for cheque printing. The last-mentioned case requires the use of a mechanism to swing the print heads assembly into contact with the tally roll paper supply (after cheque printing has been completed). Thus, notwithstanding the duplicate printing facility involved, a thermal dot matrix printer is a preferred option.

A practical example of cheque writing apparatus will now be described by way of example.

In the Accompanying Drawings:—

Figure 1 is a perspective view of a cheque writing machine enclosed by a casing;

Figure 2 shows the top cover of the casing partly lifted for access to the interior components of the machine;

Figure 3 is a part cutaway plan view of the machine;

Figure 4 is an elevational view of the operative

components within the casing as seen from one side;

Figure 5 is an elevational view of a tally roll printer as seen from the other side within the casing;

Figure 6 is a plan view of the cheque input;

Figures 7A and 7B show the effects of continuous and intermittent cheque movement at the printing station;

Figure 8 shows a modified cheque transport mechanism in diagrammatic elevational view;

Figure 9 shows a detail of the embossing station in plan view;

Figures 10A and 10B show one possible arrangement of prining mechanism;

Figures 11A and 11B show an alternative arrangement of printing mechanism;

Figure 12 indicates an alternative printing method;

Figures 13A and 13B show a preferred arrangement of printing mechanism, Figure 13B being a cross section to a reduced scale on line XX in Figure 13A; and

Figure 14 is a schematic diagram of the microcomputer interface system.

Description of Embodiments

Figure 1 shows one possible arrangement of casing 10 for a cheque writing machine. The casing is moulded of suitable plastics material in interfitting lower and upper parts 10A and 10B, the operative parts of the machine being fitted within the lower part 10A so that the upper part 10B serves as a removable cover for access purposes. Figure 2 shows the cover 10B partly lifted off. The cover has a sloping front 10C apertured on one side to receive and expose a keyboard 11 and display 12 carried by the lower part 10A of the casing 10, said sloping front 10C being formed on the other side with a slotted recess 10D which constitutes a cheque and cheque guarantee card input. To the rear, the cover 10B has a slotted recess 10E constituting a cheque card output. After writing, the cheque emerges from the input 10D.

This arrangement of the casing 10 is able to incorporate a tally roll mechanism generally to the rear of the display 12, by the side of the cheque and cheque card handling mechanism. However, many alternative arrangements of the external casing 10 are possible, some having a longer cheque transport path, for example to adapt the machine for wall mounting or for accommodation in a narrow space with the tally roll mechanism to the rear of the cheque and cheque handling mechanism. The casing may be wholly moulded of such plastics material as polyurethane foam, partly moulded of plastics material and partly formed of metal, or wholly formed of metal such as heavy gauge aluminium.

Figure 3 is a part cut-away plan view of the casing 10. The keyboard 11 has numeral keys 0 to 9, numeral separator key, clear key C, cheque card key CC, cheque key CH, enter key E, and tally key T. The display 12 is a six digit display. The reference 13 denotes the tally roll and the reference 14 designates a cheque in the cheque handling mechanism partly visible beneath the cutaway portion of the cover 10B.

Figure 4 shows one possible arrangement of the cheque and cheque card handling mechanism within the casing 10. At the cheque input/output 20, a stationary support tray 22 including cheque guide 24 and cheque card guide 26 (see Figure 6) enables a cheque 25 and cheque card 27 to be transported by a driven roller 28 to an embossing station generally designated 30. The embossing station 30 includes an ink roller 32. Both the cheque and the cheque card are inserted end-on, but the cheque card is entered face downwards on to the face of the cheque so that, on arrival at the embossing station 30, the embossed information standing out from the face of the cheque card is reproduced on the back of the cheque as the cheque passes the ink roller 32.

A separating plate 34 then routes the cheque card to the cheque card output 36, while the cheque is transported on to a movable cheque support tray 37. The position of the tray 36 to receive the cheque is designated 36A, and conveniently this is the normal position of said tray into which it is urged by means of a spring (not shown). A solenoid 38 is then temporarily operable to pivot the tray into the position designated 36B, thereby in use laterally to displace the cheque from the output path from the embossing station 30 into an input path to a printing station 40. A driven roller assembly 42, including a pinch drive roller 44, then transports the cheque through the printing station 40, which is disposed on the opposite side of the ink roller 32 from the embossing station 30. At the printing station 40, a print head, more particularly a multiple print head 43 of the dot matrix type, strikes against the back of the cheque to the ink roller 32, whereby to effect writing of the cheque on the date line, payee identification line and cash amount line, as will be explained hereinafter. The reference 45 denotes a common belt drive from a motor 46, which belt drive passes around both the driven roller 28 and the driven roller 42A of the roller assembly 42 (which has local belt transmission 42B to the pinch drive roller 44), whereby said motor 46, driven unidirectionally, serves both for transport of the cheque and cheque card through the embossing station 30 and transport of the cheque through the printing station 40. The datum position of the cheque to initiate preparation for printing is sensed by an optical sensor 48. Alternatively, a suitable microswitch may be employed. After writing, the cheque is returned to the input/output 20.

The cheque handling mechanism shown in Figure 4 is located within the right-hand side of the casing 10 as seen in the plan view of Figure 3. On the left-hand side of the casing 10, to the rear of the keyboard and display, is located a tally roll print mechanism. This is shown in Figure 5 and comprises, in addition to the tally roll paper supply 13, a series of tally roll print wheels one of

which is shown at 49 indexed by tally roll print solenoids one of which is shown at 50. A tally roll take-up spool 51 is located beneath a removable security cover 53 to allow it to be collected at the end of an accounting period, eg each day, week etc. As indicated in Figure 3, the tally roll paper supply may be replaceable through an aperture 10F in the cover 10B of the casing 10, so that the cover 10B does not have to be lifted off for this purpose.

If the cheque is driven continuously end-on through the pirnt station(X coordinate direction) and the dot matrix print head assembly is scanned in the Y coordinate direction up and down the cheque, the print will appear in the form indicated in Figure 7A. For most purposes this will not be acceptable, and it is therefore preferred to drive the cheque intermittently during printing, so that square printing of the form indicated in Figure 7B is achieved. The necessary intermittent drive is obtainable, in the above-described drive system, by means of a discontinuous worm or geneva drive (not shown) interposed in the transmission between the belt 44 and the driven roller 42A.

Figure 8 shows a preferred cheque and cheque card transport mechanism. This is generally similar to the arrangement previously described with reference to Figure 4, but includes a more sophisticated drive system.

In Figure 8, the static tray for cheque input/output and the cheque card input is designated 60, a cheque card guide is referenced 61, the cheque card output is indicated at 62 and the pivotted cheque support tray for lateral displacement of the cheque is referenced 64, with its controlling solenoid being indicated at 66. The ink roller 68, conveniently a Nylasint (Trade Mark) roller, again serves both for embossing and for cheque writing with a multiple head dot matrix printer (not shown).

As before, a single drive motor 70 is employed. A main toothed drive belt 72 operates from the output of motor 70 around a drive pulley 74 in spring loaded contact with a reaction roller 74A, an adjustable pulley 76 and a drive roller 78 cooperating with a spring loaded reaction roller 78A. A cheque card drive roller 80 (also serving to drive the cheque through the embossing station) is coupled by a toothed belt 82 to drive pulley 74. An additional drive roller is provided at 84 driven by a belt 85.

At the embossing station, the cheque card drive roller 80 is spring loaded (see indicated slot 86) towards the ink roller 68 but not allowed to make contact therewith. This ensures that the cheque is not smudged by ink deposits on the drive roller 80. The positive drive takes place between the card drive roller 80 and two auxiliary rollers (not shown) mounted coaxially with the ink roller 68 but of slightly larger.

The print needles of the dot matrix printing head, when activated, press the cheque locally against the ink roller to produce the appropriate ink dots for character formation. By using a non-floating mounting for the ink roller 68 it is not necessary to specifically provide for clearance between the roller and the cheque although in practice a gap typically in the range 0—0.5 mm will be provided.

Figure 9 shows a detail at the embossing station, where a print wheel 90 coaxial with the card drive roller 80 acts, simultaneously with embossing of the back of the cheque with the raised information on the cheque card, to mark on to the back of the cheque relevant information relating to the payee, such as the shop location in the case of a multiple chain store.

The requirements for the printing mechanism will now be discussed. First, printing has to be effected on three lines on the cheque (for almost all cheque types), partly in numerals and partly in letters and other symbols. The maximum number of characters to be printed, taking the three lines together, is of the order of 90. The three lines to be written fall in a band about 40 mm deep common to the cheques of nearly all the major banks, but within this band the relative levels of the three print lines vary, as do the positions for commencing printing on the three lines.

Upper case (i.e. capital) letters are acceptable, and a character size not less than 3 mm high×2 mm wide is desirable.

In order to achieve overall cheque acceptance within a cycle time of about 8 seconds, the cheque writing operation by printing should occupy not more than about 5 seconds.

The use of character print wheels is rejected primarily due to difficulties of controlling a wheel of the relatively large overall size which would be necessary, but dot matrix printing on a 7×5 dot format is a suitable printing form; for the font size mentioned the dot spacing will then be of the order of 0.5 mm.

However, dot matrix printing by a single needle is not practicable, within the required printing time, due to the relatively large area of cheque to be scanned. It would only be possible to overcome this problem with fast scan and line feed over the non-printed cheque areas, and this would necessitate expensive servo-control loops and precision drives. The problem is therefore best solved by the use of multiple print heads, and this is considered an essential requirement of the cheque writing machine herein described. However, within this constraint, several printing techniques are possible.

For example, assuming a maximum number of characters of 50 in one line, and a column of multiple print needles for producing characters on a 7×5 dot matrix format, 250 scans are required, giving 20 ms. per scan. Assuming a reasonable operating frequency for the print head of say 500 Hz, 10 cycles are possible per scan, meaning that 10 dots can be printed in each scan. With a width of scan of 40 mm and a dot pitch of 0.5 mm, the number of heads required is 8, each covering an amplitude of oscillation of about 5mm (10 dots).

Figures 10A, 10B and Figures 11A, 11B show two possible print head assemblies having an array of eight print needles.

Figures 10A and 10B show in diagrammatic end and side views a print head assembly 100 having eight needles 102 mounted on a scanning bar 104 driven by a drive cam 106 affording a 5 mm scanning amplitude. Reference 108 designates a cheque above an ink roller 110.

The alternative arrangement shown in Figures 11A and 11B represents a departure from the basic system previously described, in that the ink roller 120 used at the embossing station 122, where a cheque card 124 and a pinch roller 126 are also shown, is not used for printing. Instead, at the printing station 128, a helical drive hammer printer is used. This comprises an assembly 130 of eight print hammers 131, scanned by means of a rotating spiral knife 133 of 5 mm helical pitch. In Figure 11A, the reference 134 denotes a print ribbon through which the hammers strike the cheque when selectively actuated by a solenoid 136. A print guide 138 is also shown.

A further possible printing method is indicated in Figure 12. Instead of using the conventional techniques for dot matrix printing of a seven needle column scanning along the print line, in the X-direction, as indicated at 140, a five needle row 142 (extending in the X-direction longitudinally of the cheque) is scanned in the Y-direction (up and down the cheque). Thus, a single scan completes all characters in the five column width of the multiple needle head. Although each scan necessarily takes longer, since it has to cover the full printing band of the cheque, the total number of scans required is much smaller. It will equally be apparent that the incremental line drive of the cheque will be in increments five times as great as the increments required for the eight needle column arrangements of Figures 10A, 10B and Figures 11A, 11b.

A preferred print head assembly is shown in Figures 13A and 13B. This is advantageous in avoiding high accelerational forces required with the five needle row method and the more complicated control requirements to provide the electronic offset necessary to enable more than one needle to contribute to the printing of a single character (dependent on print line position) with the eight needle column arrangements.

Figure 13A shows a print head assembly 150 comprising three single wire print needles 152A, 152B, 152C operable by solenoids 154A, 154B, 154C respectively carried by parallel links 156A, 156B, 156C pivotally mounted between a common transverse support 158, and three independently movable transverse supports 159A, 159B and 159C; with link 156A being pivotally joined to support 159A etc. The supports 159A etc are longitudinally movable in the Y-coordinate direction of the cheque 160. The common support 158 is movable to effect scanning under the control of an eccentric 162 driven by a motor 164. The supports 159A, —B and —C are movable under the control of an adjustment mechanism 166, which selectively steers the three supports and therefore the needles 152A, —B and —C to base levels, from which scanning takes place, which correspond to the levels of the three respective print lines on cheques of differing types. The adjustment mechanism 166 shown in the drawing provides four adjustment positions 166A, 166B, 166C, 166D to enable four substantially different cheque formats to be handled. In practice it is found that this will permit most current clearing bank cheques to be accommodated. If more cheque formats have to be handled the mechanism 166 may have to incorporate an increased number of positions. The adjustment mechanism 166 can be driven by a suitable power source in accordance with stored information as to the positions of the print lines on the various cheque types. The same information may be used to control a motor and Geneva mechanism for steering the print heads to the appropriate base levels.

Referring to Figure 13B, one of the needles 152A, —B and —C (namely 152C) is shown. The three needles serve to print the cheque date line (needle 152A), the payee identification line (needle 152B), and the cash amount line (needle 152C). Reference 168 denotes a commutator with a commutator wiper 168A.

Although the printing mechanism of Figures 13A and 13B requires the provision of a steering adjustment mechanism, the substantial advantage is gained that scanning of the non-printed areas of the cheque is avoided. The maximum steering adjustment required for each print needle is 10 mm, and thereafter the required scanning amplitude is only about 3 mm (7 dots).

It should also be mentioned, in connection with all the print mechanisms which have been above referred to, that it is preferred for synchronisation purposes to employ the same drive motor as the power source for scanning as the motor used for cheque and cheque card transport.

With regard to print speed requirements, the cheque length is about 150 mm, so that with the dot matrix format previously mentioned and a maximum number of characters in one line of 50, a dot rate of 466 Hz is required. This is reasonably practicable, but it may be preferred to allow a total print time of 6.5 seconds at a dot rate of about 350 Hz. With an average cheque speed of 30 mm/sec, and 10 ms (out of a total of 100 ms) for incrementing, the speed of the cheque during incrementing will be 300 mm/sec. This is not difficult to achieve with the described arrangement in which only the cheque is moved, i.e. no cheque support or the like is transported.

Referring briefly to print energy requirements, it can be expected that each dot will require an impact energy of about 0.6 mJ, which allowing for solenoid efficiency and the like will mean a peak power input of about 20 watts at an operating frequency of about 350 Hz.

With regard to the tally roll printer, one possible form thereof has been briefly described with reference to Figure 5. In the preferred machine, a thermal dot matrix printer is

employed, for example an electronic discharge printer manufactured by Sharp Corporation under Model Number DC—1606D or DC—2106D. The cost of such a separate tally roll printer appears less than the expense involved in providing a mechanism which would enable the print heads for cheque writing to be swung into an alternative operative position for tally roll printing. Both of the printers mentioned are capable of printing, for each cheque, the cash amount, the number of cheques totalled, and the cumulative cheque cash total.

The description so far has not considered the electronic equipment provided in the cheque writing machine. However, such equipment is essential for two purposes; first to process the entries made at the keyboard (eg the first two or more digits of bank code to identify cheque type and cash amount in numerals) and second to provide the information to enable the print mechanism to write the date line and the payee identification line. These facilities are conveniently provided by a microcomputer provided with a clocked input. Microcomputers with the required amount of ROM, RAM and I/O are necessary, preferably 8-bit microcomputers to avoid excessive software development difficulties and costs and to ensure achievement of performance criteria. Two suitable computers are:—

	ROM	RAM	I/O
ROCKWELL 6500	2048	64	32
MOSTEK 3870	2048	64	32

The clock input rate is determined primarily by the minimum acceptable refresh rate for the display. Assuming a vacuum fluorescent display is preferred to LEDs or liquid crystals, a reasonable minimum refresh rate is about 50 Hz. A clock input rate of 1/512 seconds gives a refresh rate of 64 Hz assuring 8-digits and is readily divided down to give a one second time-of-day clock, thus enabling the maintenance of a perpetual calender for date writing information. An interrupt routine of this form would take up about 25% of the available processor time.

Either of the above-mentioned microcomputers can process the necessary needle scanning interrupt handling. The needle printing rate is about 350 Hz and at each interrupt an output may be required on any of three print needles (in the preferred print mechanism). The decision whether or not to activate a needle solenoid is dependent on:

the position in scanning in the 7 high dot matrix column
the position of the column in the character
the position of the character in the text.

The most time consuming part of the needle scanning interrupt routine is concerned with referencing the decisions on solenoid activation back through the three above-listed positions. Assuming a time of 100 μs per solenoid, 20% of the available processor time will be consumed.

The handling of cheque and tally roll interrupts is simpler and less time demanding, and may occupy less than 15% of the available processor time.

The software will be table driven for which purpose the RCM will store the following tables:

ASCII to dot matrix table (for all printing)
binary coded decimal to seven segment table (for the display)
cheque datum table, giving the X and Y coordinate positions of print start for each of the three print lines of cheques of differing types
month table (for date writing with month in letters)
number table (alphabetic forms of numerals for cash amount writing)
payee identification table in ASCII form.

The above tables may be considered part of the clock interrupt routine provided by the software, which routine also includes:

updating of time-of-day and calendar clocks,
display of next digit,
sensing of keyboard, with debouncing,
latching of control outputs,
sensing of status inputs.

The ROM will require approximately 800 bytes for tables and approximately 1000 bytes for program, while the RAM will require approximately 40 bytes for defined data (keyboard input) and approximately 20 bytes for working, both requirements being within the capacity of the microcomputers previously mentioned.

The specific interface requirements of the microcomputer for the preferred machine are summarised below:

16 element keyboard
5 digit 7 segment display with decimal points
cheque transport control
  motor on/off output
  datum reference input
  incremental reference input
needle scanning control
  motor on/off output
  datum reference input
  incremental reference input
  3 solenoid outputs
needle position control
  motor on/off output
  datum reference input
tally motor control
  motor on/off output
  datum reference input
  incremental reference input
  7 column outputs
miscellaneous inputs and outputs
  4 year inputs
  audio indicator output
  status lamp outputs
  battery low input
1 second clock input

These interfaces are represented graphically in Figure 14, which shows one economical implementation.

The keyboard, display and low speed latched inputs and outputs are effectively integrated. In

this way only 15 lines are used for what would, if implemented discretely, require at least 30 lines.

The processor regularly increments the 3 bit output which is passed through a 3:8 decoder to give a rotating strobe signal. This is then used for four purposes:

- to latch control outputs
- to gate status inputs
- to scan the keyboard matrix
- to scan the display digits.

The display segments, relating to the current digit, are outputted on an independent port.

The cheque needle and tally datum positions are fed in separately as these must be rapidly accessible.

The cheque, needle and tally incremental signals are fed in as interrupts, thereby allowing background processing to proceed while printing takes place. The exact assignment of these signals is dependent on such factors as the type of tally roll printer.

The motor on/off controls and the miscellaneous control and status signals are handled via the control and status lines described above. These lines must be restricted to signals which do not require rapid change or attention, and it is preferable that the motor on/off signals should be handled independently.

The clock input signal is derived from the processor clock, which is crystal controlled.

The power supply to the cheque writing machine will be an unregulated 12 V d.c. signal, taken from a till accumulator or a mains supply adaptor. Within the machine, power supply circuits will provide independent supplies as follows: 5 V d.c. for logic circuits, 30 V d.c. for vacuum fluorescent display where this is the chosen display technique and a motor power supply appropriate to the motor(s) employed. The supply for the logic circuit will be well regulated, but requirements for the display and motor(s) are less stringent, provided that the motor supply is maintained sufficiently accurately to keep mechanism speeds within reasonable limits.

The preferred machine of this invention enables a rapid cheque acceptance system having the following steps:—

1) presentation of blank cheque and cheque card to cashier

2) insertion of cheque and card into machine and entry of cheque type and cash amount on keyboard

3) return of written cheque to customer for signature

4) verification of signature

5) return of cheque card to customer.

The particular embodiments of the machine described with reference to the drawings may be modified in various ways within the scope of the invention as defined in the appended claims, within the essential requirement to provide a keyboard for entry of cheque type, a memory to store this entry and the entered cash amount, and a processor for controlling the positions of printing in accordance with the stored information of cheque type. While it is envisaged that entry of the first two digits of the bank code is the simplest way of identifying cheque type, other methods can readily be envisaged. With regard to the date to be written on the cheque, it would be possible to store this information on the basis of a keyboard entry at the beginning of each day, thus avoiding the requirement for maintenance of a perpetual calender. Finally, the above-described mechanical mechanisms are considered to represent a relatively simple and inexpensive way of implementing the invention with a minimum of electronic control. However, more sophisticated mechanisms, requiring a more complex microcomputer with greater processing capacity, are not excluded.

Claims

1. Cheque writing apparatus comprising means for transporting a blank cheque to a printing station and for transporting a written cheque from said station, a multiple head printer at the printing station, a keyboard for entry of the cheque type and the cash amount to be printed, a memory for storage of date, payee identification and positional data for printing in relation to the cheque type, a drive mechanism for the multiple head printer, and a microprocessor for controlling the drive mechanism for the printer in relation to the cheque transport means to cause the printer to complete the writing of the cheque responsive to the entered keyboard information and the information in the memory.

2. Apparatus according to claim 1, wherein the memory stores Y-coordinate information relating to the levels of the date line, payee identification line and cash line on cheques of differing types and X-coordinate information relating to the lateral positions across the cheque for commencement of printing at the level of the date line, payee identification line and cash line on cheques of differing types, and the microprocessor is operative to control the cheque transport means for incremental movement of the cheque through the printing station in the X-coordinate direction, to control the printers drive mechanism to effect scanning of the printing heads in the Y-coordinate direction and to initiate printing by the printing heads selectively in response to the X-coordinate and Y-coordinate information.

3. Apparatus according to claim 2, wherein the multiple head printer is a printer having three print heads, one each for date line, payee identification line and cash line.

4. Apparatus according to claim 3, wherein the microprocessor is initially operative selectively to adjust the base levels of the three print heads in response to the Y-coordinate information, and to effect equal simultaneous scannings of the three print heads in the Y-coordinate direction relative to their adjusted base levels.

5. Apparatus according to any of claims 1 to 4, wherein each print head is a single needle for dot matrix printing.

6. Apparatus according to any of claims 1 to 5, wherein the keyboard is a numerical keyboard for entry of numerals identifying the cheque type and numerals designating the cash amount, and the memory includes a bank code to positional data conversion table and a number table for conversion of cash amounts entered in numerals to semi-alphabetic cash amounts for writing of the cheque ahead of the numerical cash amount box.

7. Apparatus according to claim 6 when appendant to claim 5, wherein the memory includes an ASCII to dot matrix conversion table.

8. Apparatus according to any of claims 1 to 7, wherein the microprocessor is operable to maintain a perpetual calendar stored and updated in numerical form, and the memory includes a month conversion table for converting numerical months to alphabetical months for writing of the date line of the cheque.

9. Apparatus according to any of claims 1 to 8, including a cheque embossing station ahead of the printing station, means for transporting the cheque and a cheque guarantee card to said embossing station, where embossed information on the cheque card is printed on to the back of the cheque, and means whereby the cheque card is delivered from the embossing station to an output and the cheque transport means is operative to carry forward the cheque to the printing station.

10. Apparatus according to claim 9, wherein a common ink roller is employed for embossing at the embossing station and cheque writing at the printing station, the said stations being located on opposite sides of said roller.

11. Apparatus according to claim 9 or claim 10, having a single drive motor for driving the cheque and cheque card through the embossing station and for driving the cheque through the printing station.

12. Apparatus according to any of claims 9 to 11, including at the embossing station a print wheel for providing an embossed image relating to payee identification on the back of the cheque.

13. Apparatus according to claim 2 or any claim appendant thereto, having a common drive motor for cheque transport and printing heads scanning, the transmission from the carrier drive motor to the cheque including an intermittent mechanism such as a discontinuous worm wheel operative for incremental movement of the cheque through the printing station.

14. Apparatus according to any of claims 1 to 13, including a tally roll printer, and means whereby the microprocessor updates at each cheque writing operation a cumulative total of cheque cash amounts stored in the memory and causes the tally roll printer to be actuated at each update.

15. Apparatus according to any of claims 1 to 14, including a display interfaced with the microprocessor to enable the operator to check information entered through the keyboard.

16. Cheque writing apparatus substantially as hereinbefore described with reference to the accompanying drawings.

New Claims or Amendments to Claims filed on 23 June 1981.
Superseded Claims 1.

New or Amended Claim:—

1. Cheque writing apparatus comprising means for transporting a blank cheque to a printing station and for transporting a written cheque from said station, a multiple head printer at the printing station, a keyboard for entry of the cash amount to be printed and of a cheque type code for distinguishing between types of cheque having differing formats for the writing of date, payee identification and cash amount, a memory for storage of date, payee identification and positional data for printing in relation to the cheque type, a drive mechanism for the multiple head printer, and a microprocessor for recognising the entered cheque type code and for utilising stored positional data corresponding to said entered code to control the drive mechanism for the printer in relation to the cheque transport means to cause the printer to complete the writing of the cheque in accordance with its format responsive to the entered keyboard information and the other information in the memory.

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